900919

INSTRUCTION AND MAINTENANCE MANUAL

FOR

SERIES 440 SINGLE PHASE

PHASE ANGLE CONTROLLER

Barber-Colman Company
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MP MASTER
MA32118

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1.0 All part numbers are of the form:

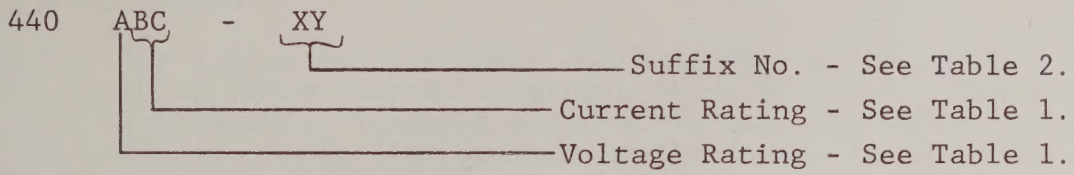


TABLE 1

VOLTAGE		CURRENT	
A	AC INPUT	BC	AMPS
1	120 VAC		
2	240 VAC	02	25
3	480 VAC	03	50
4	277 VAC		
5	600 VAC	04	75
6	208 VAC	05	100
7	380 VAC		
8	415 VAC	07	160
		08	220
		10	310
		11	400
		12	550

TABLE 2

Suffix No.	Ramp	Current Limit Option
01	Standard	Without
02	Standard	With
03	Long	Without
04	Long	With
05	Fast	Without
06	Fast	With

2.0 INTRODUCTION

2.1 The Series 440 SCR power controllers provide solid-state phase angle control of single phase AC power. The SCR's (thyristors) serve as solid-state switches which, when closed, apply line voltage to the load. In phase angle control, each SCR is turned on for a controlled portion of a half-cycle of the line voltage. The effective voltage (hence power) is determined by the portion of the line voltage delivered. The load voltage can then be varied by selecting the firing time of each SCR.

3.0 POWER REQUIREMENTS

3.1 All units are rated for nominal 1Ø A.C. line voltage +10% @ 50/60Hz. Standard ratings are 120V, 208V, 240V, 277V, 380V, 415V, 480V, and 600V. Units shut down automatically if line voltage drops below 70% of nominal value. Normal operation will return with recovery of line voltage.

4.0 LOAD RATINGS

4.1 RMS load voltage is controllable from zero to 100% of line voltage. Linearity is ±2% of full output voltage from 5% to 96% of the input voltage.

4.2 Refer to the nameplate for current rating. RMS load current rating is for continuous operation in free air at ambient temperatures of 50°C (122°F) or less. The load resistance should be such that under conditions of maximum line voltage, the nameplate current rating is not exceeded. Units for operation above 50°C are available on special order. See Section 7.11, page 5. Typical momentary overload capability is 300% of RMS nameplate rating for 10 cycles.

4.3 These units may be operated into resistive or inductive loads either directly or through an interposing transformer.

4.4 Special precautions are necessary to limit peak inrush currents when these units are driving tungsten lamp loads. Units having a "X3" as the part number suffix have a 4-second ramp built in to limit the rate of rise of the output voltage to control load heat up. These units are intended for operation into high inrush loads. (See Para. 1.0.)

4.5 All units use current limiting Amp-Trap Form 101 type 4 fuses. Replace only with fuses of identical type, voltage rating and current rating.

4.6 An on board current limiter is available. In certain applications with high temperature heating elements such as Platinum, Tungsten, or Molybdenum, current limiting is needed. These loads, when cold, draw 10 to 15 times the current drawn when hot. Under initial starting conditions, the cold load could draw enough current to blow fuses, even after the initial "soft start" action of the controller is complete.

5.0 CONTROL REQUIREMENTS

5.1 All units may be controlled with remote manual 3K ohm potentiometer. See Figure 1, page 13.

5.2 All units may be controlled by an external voltage signal delivering 0-6VDC to 0-19VDC into 3K ohms. See Figure 2, page 13. The full range of control may be adjusted by the gain control.

5.3 All units may be controlled by instruments delivering 0-5 mA, 2-12 mA, 4-20 mA or 10-50 mA into various terminating impedances. See table on page 14.

6.0 METERING

6.1 Many AC meters encountered will not provide meaningful readings of waveforms encountered in phase angle controlled SCR circuits. The relationship between the average value and the RMS or "heating" value is neither constant nor linear. See chart, page 15.

6.2 Recommended meters: A thermocouple type or iron vane meter will give the most accurate RMS readings.

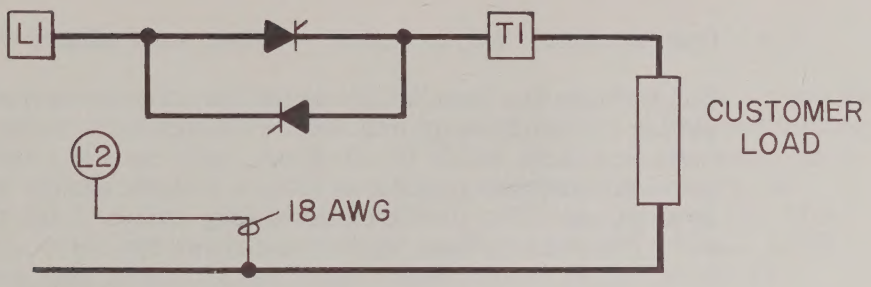
7.0 INSTALLATION AND OPERATION

7.1 Installation Precautions

7.11 These convection cooled panels are rated for operation in ambients of 50°C (122°F) maximum. They should be mounted with heat sinks vertical in open air spaces. If the panels are mounted in spaces with restricted air flow, precautions should be taken to ensure an ambient of less than 50°C.

7.2 Power Connections

7.21 Input Connections. Connect the incoming lines to terminals L1, L2. Connect the load connections to terminals T1, L2. See note next page.



7.3 Control Connections

These units are designed to operate from a manual control potentiometer of 3000 ohms to 50,000 (3000 recommended). Voltage or current control may also be used; see Para. 7.31, page 7.

7.31 Manual Control - Remote Potentiometer (See Figure 1, page 13.) Connect the remote 3K ohm potentiometer to the gate trigger unit as follows: Connect the clockwise end of the pot to terminal #7, the wiper to terminal #3, and the counter-clockwise end to terminal #1. Clockwise rotation will increase the output. The resistance of the pot should be between 3K ohms and 10K ohms, although values up to 50K ohms may be used with reduced control linearity.

7.32 Voltage Control. (See Figure 2, page 13.) Connect the positive end of a variable voltage source to terminal #1 of the G.T.U. and the negative end to terminal #3. The unit will accommodate sources from 0-6 Volts to 0-19VDC. The input resistance is 3K ohms.

7.33 Current Control. (See Figure 3, page 13 and Table I, page 14.) Connect the positive end of a variable current source to terminal #1 of the G.T.U. Refer to Table I on page 14 and Figure 3 on page 13 for the negative connection and required jumper(s).

7.34 Special current control connections. Input current ranges and input resistance values other than those shown in the Table are obtainable with external resistance networks which will deliver 0-6 mA nominal (20 mA max.) to terminals #1 and #2. Input voltage drop across these terminals is one transistor base to emitter voltage of 0.6 to 0.8VDC.

7.4 Operational Adjustment - Bias and Gain

Units may be precalibrated to the instrument if advised prior to shipment of its characteristics. Otherwise, calibration will be 0-5 mA, which is idential to remote potentiometer calibration. Calibration procedures below are given for troubleshooting only. Do not attempt to recalibrate a new unit needlessly.

7.41 Calibration Check. Connect an AC voltmeter across output and DC milliampere meter in series with instrument. A load must be applied to power controller. If current limiting is used, a light load is required to avoid interaction with the limiter. Apply power and run controlling instrument from its minimum to maximum level, noting minimum and maximum outputs from the controller. If calibration is necessary, see below.

7.42 Bias Adjustment. With load and power applied, adjust control signal or manual potentiometer to the lowest setting that is required (e.g., 4 mA on a 4-20 mA instrument) and adjust the Bias control until the output voltage drops to zero.

7.43 Gain Adjustment. Apply full control signal or manual potentiometer (e.g, 20 mA on a 4-20 mA instrument) and adjust the Gain control until the output voltage reaches maximum, approximately 96% of line voltage.

8.0 MAINTENANCE

8.1 Periodic Inspection

8.11 It is important that the controller be kept clean. A layer of dust or process waste will reduce the heat transferring properties of the heat sinks and bus bars. It is recommended that the dust be blown off periodically. The power controller must be protected from metallic or conductive particles.

8.12 All panels subjected to corrosive atmosphere should have the electrical connections periodically inspected. Tarnished connections should be cleaned and joint compound reapplied. Alcoa No. 2 Joint Compound has been applied at the factory to all bus bar connections and is recommended for field reapplication. Refer to the instructions on the can for proper joint preparation.

8.2 Component Replacement

To remove semiconductor or Plastic-Pak devices, remove the power terminal connections and the device mounting screws. Clean the heat sink with alcohol or soap and water, then dry. Apply a thin coating of Alcoa No. 2 Electrical Joint Compound (EJC) to the bottom of the Plastic-Pak or semiconductor and mount to heat sink. For torque specifications, see Para. 9.5, page 11.

9.0 TROUBLESHOOTING

The following checks can be made with a multimeter. Replacement of semiconductors and Plastic-Pak devices and fuses can be made in the field, but if the trouble is ascribed to the Gate Trigger Unit, the GTU must be returned to the factory. Refer to Section 8.2 before replacing any electrical components.

WARNING

EXPOSED BUS BARS, HEAT SINKS, AND MANY TERMINALS ON THE GATE TRIGGER UNIT INCLUDING GTU TERMINALS WHICH ARE SCR (GATE-CATHODE) CONNECTIONS ARE AT FULL POTENTIAL. ALWAYS DE-ENERGIZE THE PANEL BEFORE CONNECTING OR DISCONNECTING ANY METERS OR WIRING. BE EXTREMELY WARY OF METER LEADS WHICH MAY POP OFF OR SLIP AND SHORT TO OTHER TERMINALS. ALWAYS WORK WITH ONE HAND AND WEAR SAFETY GLASSES.

DO NOT WORK ALONE. DO NOT CONNECT ANY NON-ISOLATED METERS OR OSCILLOSCOPES TO THE PANEL. CAREFULLY RECHECK ALL WIRING BEFORE APPLYING POWER.

9.1 Symptom No output.

Probable Cause: No input.

Remedy: Check for rated input voltage.

Probable Cause: Incorrect wiring of external circuit.

Remedy: Check for proper load connections.

Probable Cause: Incorrect bias setting or input signal.

Remedy: Check settings as per Section 7.4 and readjust if necessary.

Probable Cause: Blown Fuses

Remedy: Open power to controller. Disconnect one end of each suspected fuse and check resistance with ohmmeter. It should measure less than 1 ohm. Replace, if necessary, with SAME TYPE. DO NOT INSTALL ANY OTHER TYPE OF FUSE. Measure load resistance (with panel disconnected) and make sure that panel is not being used beyond its rated current. Check for high input voltage.

9.2 Symptom: Full output or lack of control.

Probable Cause: Bias, gain, or input signal too high.

Remedy: Check settings as per Section 7.4 and readjust, if necessary. Refer to Table on page 16 for bias and gain limits. If turning gain control to max. CCW position does not cause output to decrease, input signal or bias is too high. With input signal disconnected, turning bias control CCW should cause output to decrease.

Probable Cause: Malfunctioning diode or Plastic-Pak Semiconductor.

Remedy: Disconnect one end of each suspected diode and measure resistance with ohmmeter leads connected both ways. Unit should read high (1 million ohms or greater) with the arrow point positive and low (5 to 15 ohms) with the arrow point negative. If diode reads essentially zero with both polarities, diode is shorted; if high, diode is open. Replace if necessary.

Probable Cause: Malfunctioning SCR's or Plastic-Pak Semiconductor.

Remedy: Disconnect the leads of a suspected SCR. Check the resistance readings for conformity to the following table:

Anode	Cathode	Gate	Ohmmeter Reading
Open	Neg.	Pos.	5 to 100 ohms
Open	Pos.	Neg.	30 ohms or greater
Pos.	Neg.	Open	1 megohm or greater
Neg.	Pos.	Open	1 megohm or greater
Pos.	Both Negative		1 megohm or greater
Neg.	Both Positive		1 megohm or greater

Because of manufacturing differences a semiconductor not conforming to this table may be good and a semiconductor conforming may be defective. In the latter case, the semiconductor could be breaking down (conducting) when exposed to rated voltage. The only way to test for this in the field is to substitute a semiconductor known to be good. If the symptoms are cleared, the replaced semiconductor or Plastic-Pak was defective.

9.3 Symptom: Panel runs initially, then control from half output to zero output is lost. Panel cannot be turned off. Normal operation is regained after unit is allowed to cool.

Probable Cause: Poor heat conduction path from semiconductor or Plastic-Pak to heat sink, causing the device to overheat and lose its voltage blocking capabilities.

Remedy: Make sure all semiconductors or Plastic-Pak devices are fastened securely to their heat sinks. Reapply joint compound if necessary (see Section 8.2). Replace the semiconductor or Plastic-Pak if this does not correct the problem. (See torque spec., Para. 9.5.)

9.4 Symptom: Control input to output is not linear.

Probable Cause: Improper operation of the GTU.

Remedy: Make the following tests on the GTU. With both the bias and gain controls maximum CCW, there should be no output from the GTU.

DO THE FOLLOWING WITH ALL POWER OFF!

Disconnect gate-cathode leads (red and white twisted pair) at the heat sink and securely tape the ends.

CAUTION: DO NOT ALLOW ANY LEADS TO TOUCH EACH OTHER ON THE PANEL. TAPE THE LEADS. DO NOT CONNECT ANY GROUNDED INSTRUMENTS TO THESE TERMINALS.

Apply power to the unit; set bias and gain full clockwise. With a 0-10VDC meter, measure the output pairs (black and white twisted pairs). The meter reading should be steady at 4-6VDC.

If reading fluctuates or is zero on any output, unit is defective. Consult the factory. Be sure input voltage is correct in magnitude, outputs are not being shorted, and input is disconnected before judging unit defective. Do not attempt to repair the gate trigger unit. If the unit seems okay, turn off the power, reconnect the leads to the proper terminals and make the following linearity test; see Para. 10.0.

9.5 CAUTION: When replacing Plastic-Paks for 25A RMS controllers torque the mounting screws 15 lb. in. (1.2 lb. ft.). For 50 - 100A Plastic-Paks, torque mounting screws 50 lb. in. (4.2 lb. ft.). Torque the terminal screws on the Plastic-Pak 25 lb. in. (2.1 lb. ft.).

10.0 SYSTEM CHECKING

10.1 System check for non-linearities:

Assuming the panel output can be controlled from full OFF to full ON, proceed as follows:

10.11 Monitor the panel output with an appropriate voltmeter. (See Section 6.0.)

10.12 Monitor the control input using a voltmeter for voltage control, a milliammeter for current control or a calibrated potentiometer for manual control, as required. Set the bias and gain controls as previously described in Section 7.4.

10.13 With the power On and the meters connected, adjust control to 100% (full output). The meters should read 100% current or voltage as determined by load and input voltage. See the graph on page 15.

10.14 Check for conformity to the graph at various control inputs between full ON and full OFF. The control-input relationship should follow the curve given for the type of meter being used. Most multimeters such as those made by Simpson, Triplett, etc., are average reading meters. Full ON will be approximately 98% of the incoming line voltage when read by a true RMS responding meter and approximately 96% of the incoming line voltage when ready by an averaging meter.

11.0 INTERLOCKS AND SHUTDOWN

11.1 The control circuitry of Series 440 controllers may be interlocked with either a NO or NC contact.

11.2 If a normally closed (NC) contact is available, connect it in series with the command input. This would be in the arm of the manual pot or one output line of a controlling instrument. The SCR power controller will shut down (to zero output) when the contact is opened.

11.3 If a normally open (NO) contact is available, connect it across terminals 1 and 2 of the GTU. Closing this contact will cause the controller to shut down. The controller will resume normal operation when the contact is opened.

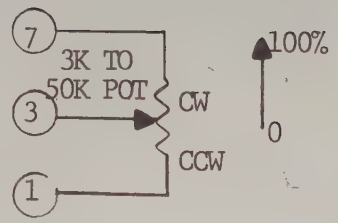


FIGURE 1

REMOTE CONTROL
WITH MANUAL POT

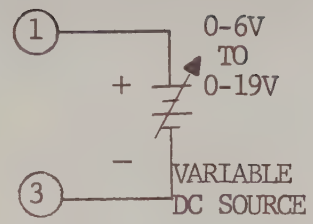
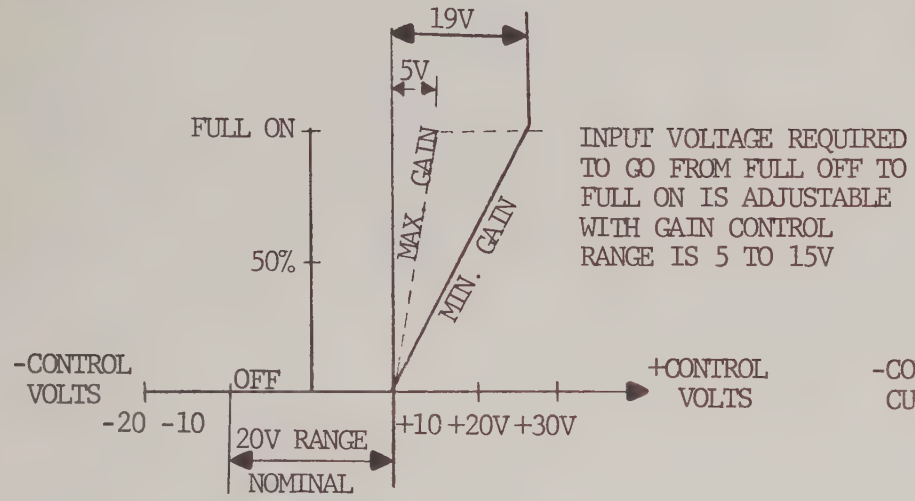


FIGURE 2

CONTROL WITH DC
VOLTAGE SOURCE

FIGURE 3

TYPICAL CURRENT CONTROL
SEE LINE 1 OF CHART ON
NEXT PAGE



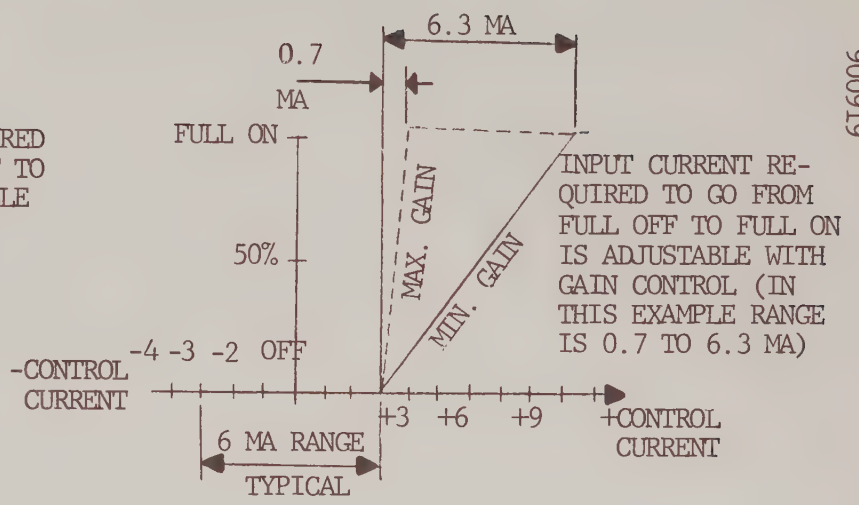


FIGURE 4

TYPICAL VOLTAGE TRANSFER
CURVE (LEFT) AND CURRENT
TRANSFER CURVE (RIGHT)

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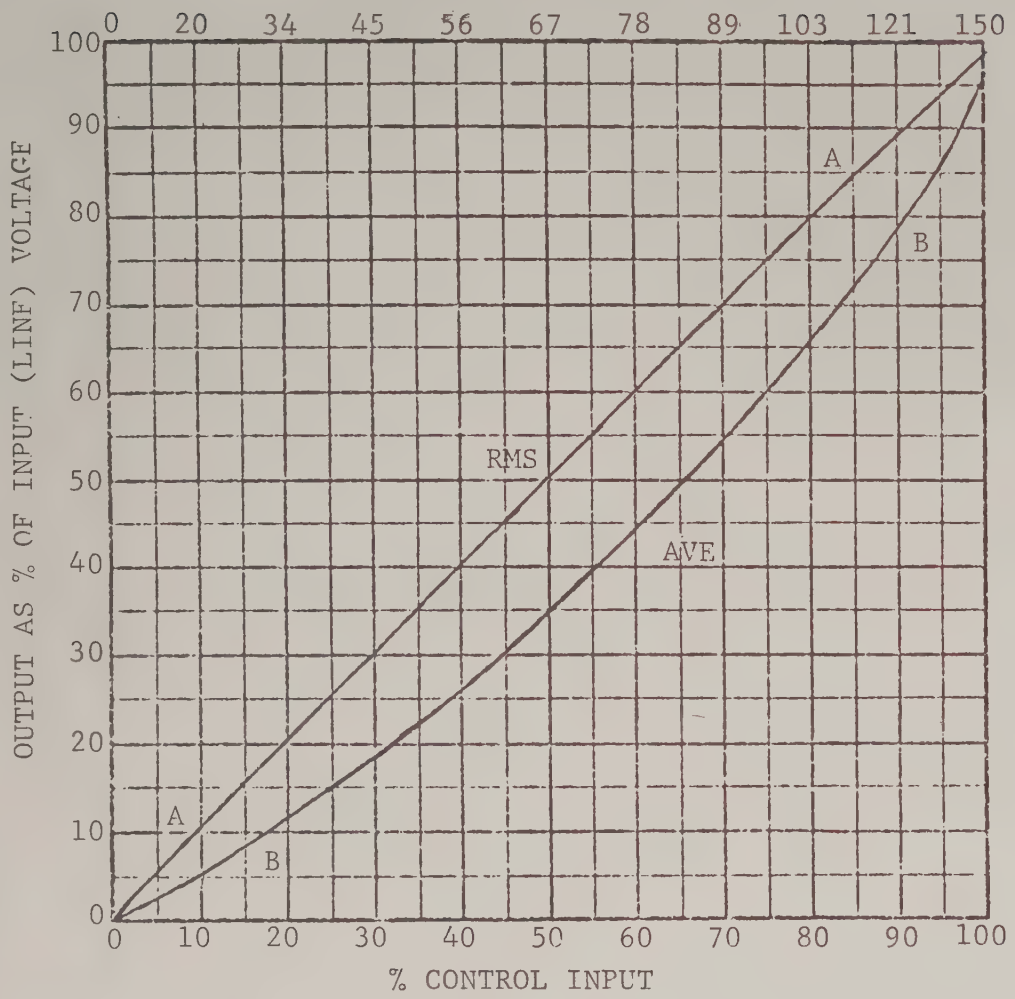
TABLE I

LINE	INPUT CONTROL CURRENT MA F.S.	DESIRED INPUT RESISTANCE OHM	INPUT CONNECTIONS TERM #1 POSITIVE	JUMP TERMINALS	MAXIMUM INPUT CURRENT MA	MINIMUM BIAS ADJ. MA	TYPICAL BIAS ADJ. MA	CONTROL CURRENT RANGE FROM FULL ON TO FULL OFF MIN, MA	MAX, MA
1	5	2K	1 & 4	2 TO 3	16	± 2.7	± 3	0.7	6.3
2	5	3K	1 & 3	------	13	± 2.7	± 3	0.7	6.3
3	5	4K	1 & 5	3 TO 4	13	± 2.7	± 3	0.7	6.3
4	6	4K	1 & 5	3 TO 4	13	± 2.7	± 3	0.7	6.3
5	12	1.5K	1 & 3	1 TO 5	27	± 5.25	± 6	1.5	12.4
6	20	0.75K	1 & 3	1 TO 5 3 TO 4	40	± 9.8	±11	2.8	23.0
7	20	1.2K	1 & 4	1 TO 6	42	± 9.5	±11	2.7	22.0
8	50	0.6K	1 & 5	1 TO 6	73	±23.8	±28	6.5	54.0

NOTE: BIAS CONTROL ADJUSTS FULL OFF POINT
GAIN CONTROLS ADJUSTS FULL ON POINT
FOR TYPICAL TRANSFER CURVE FOR LINE #1, SEE PREVIOUS PAGE.


APPROXIMATE CONDUCTION ANGLE
0 20 34 45 56 67 78 89 103 121 150
OUTPUT AS % OF INPUT (LINE) VOLTAGE
100 90 80 70 60 50 40 30 20 10 0
A
B
RMS
AVE
A
B
0 10 20 30 40 50 60 70 80 90 100
% CONTROL INPUT

VOLTAGE SCALES

(Top number in each column is A.C. line voltage)

600	480	240	120
540	432	216	108
480	384	192	96
420	336	168	84
360	288	144	72
300	240	120	60
240	192	96	48
180	144	72	36
120	96	48	24
60	48	24	12
0	0	0	0

NOTES: Curve A-A is for true RMS responding meters such as iron vane, thermocouple, etc.
Curve B-B is for average responding (rectifier type) meters such as Simpson 260, etc.

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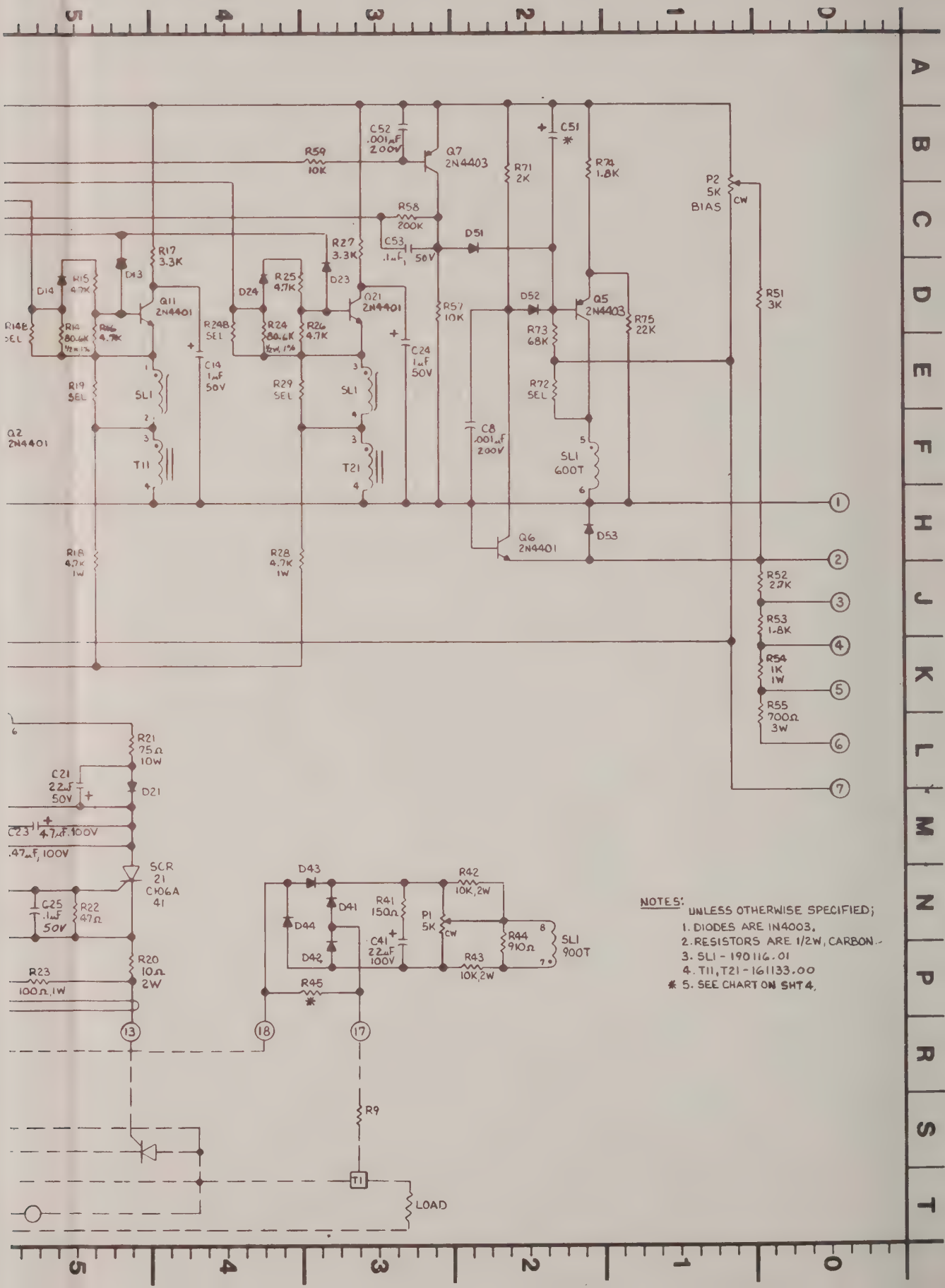
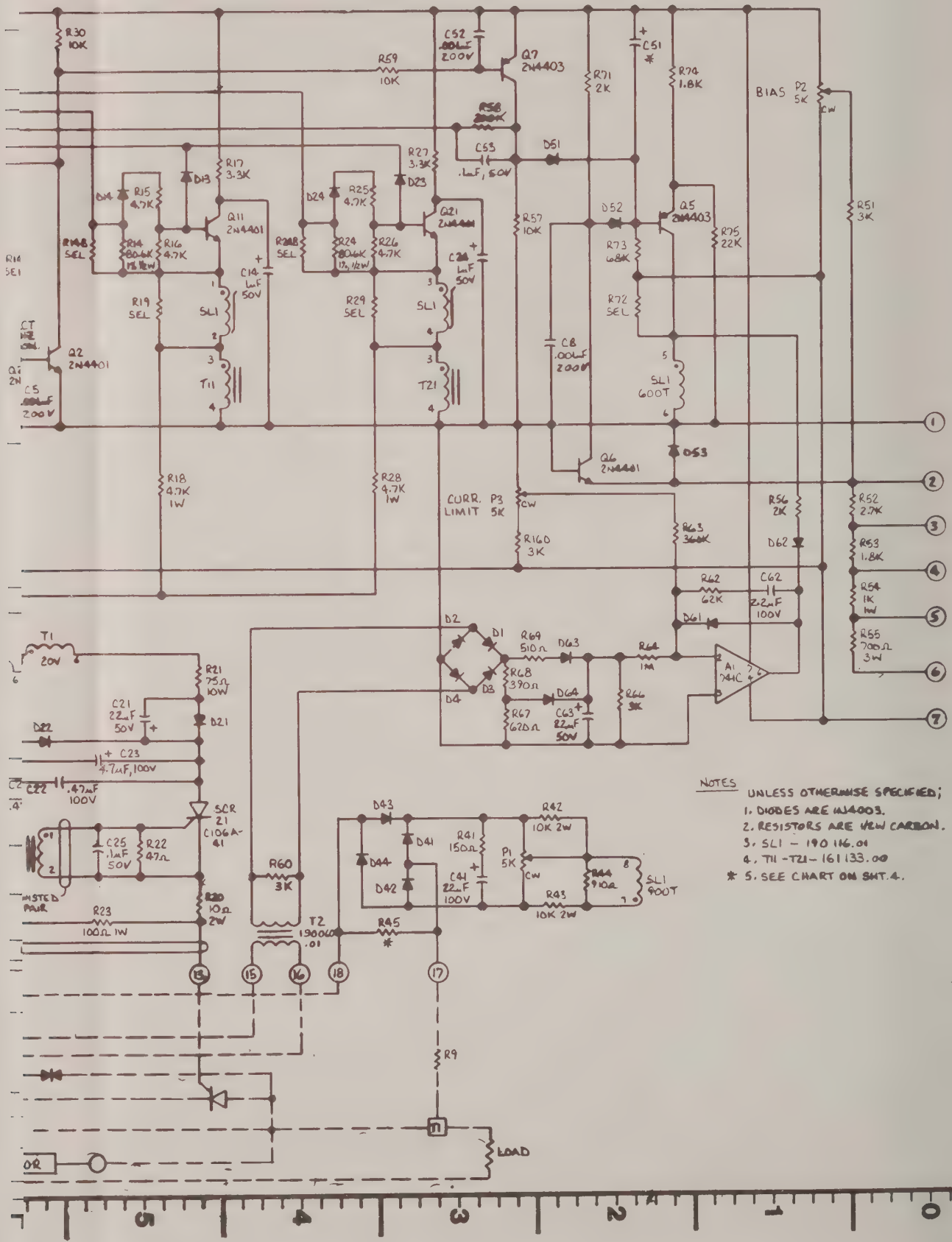
REVISIONS
A 12286 C13,C23 WAS 3.3uF
PRIMARY FOR 416 OR 480V 50/60 HZ
PRIMARY FOR 120,277,380,OR 600V 50/60 HZ
PRIMARY FOR 208 OR 240 V 50/60HZ ONLY
CONNECT FOR 50HZ OPERATION.
ROBICON CORP.
PITTSBURGH, PA.
TITLE 1Ø POWER CONTROLLER A.C. PHASE ANGLE W/C.L.
P/N 464833.XX
DWG NO 37319
REVISION A
STD. SUPPRESSOR



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. DIODES ARE IN4003.
2. RESISTORS ARE 1/2W, CARBON.
3. SL1 - 190116.01
4. T11, T21 - 161133.00
* 5. SEE CHART ON SHT 4.

REVISIONS
A 12286 C13, C23 WAS 3.3μF Reqd Calc'd/dm
PRIMARY FOR 416 OR 480V 50/60 HZ
PRIMARY FOR 120, 277, 380 OR 600V; 50/60HZ
PRIMARY FOR 208 OR 240 50/60HZ ONLY
T1 *
R1 270Ω 2W
R2 270Ω 2W
R3 SEL
R4 3.9K
R5 1.5K 2W
R6 SEL
R7 24K
R8 20K
R9 100K
R10 10Ω 2W
R11 75Ω 10W
R12 47Ω
R13 100Ω 1W
R44 15K
C1 47μF 50V
C2 47μF 50V
C3 *
C4 .47μF 100V
C11 22μF 50V
C12 .47μF 100V
C13 4.7μF, 100V
C15 .1μF 50V
Z1 1N4737A
Z2 1N4737A
Z3 1N4737A
Z4 1N4737A
Z5 1N4739A
D5
D7
D8
D9
D10
D11
D12
D15
Q1 2N4403
SCR 11 C106A-41
T11
T21
CT1
F1
TWISTED PAIR
TWISTED PAIR
STD SUPPRESS
DRAWN RRT 9-13-82
CHECKED SA 11/11/84
ISSUED
ROBICON CORP. PITTSBURGH, PA.
CUSTOMER
WORK ORDER#
TITLE 1Ø POWER CONTROLLER w/CL HI CURRENT 160-SDA (P/N 464 834)
DWG NO. 373194
REVISION A
CONT. ON SHT. 3
SHT. NO. 2
MASTER
DWG. NO. 373194
REV. A
CONT. SHT. 3
SHT. NO. 2


R30 10K
C52 .001µF 200V
Q7 2N4403
R59 10K
R71 2K
C51 *
R74 1.8K
BIAS P2 5K
CW
R58 200K
C53 .1µF, 50V
D51
R27 3.3K
D23
R17 3.3K
D24
R25 4.7K
D13
R15 4.7K
D14
Q11 2N4401
R24 80.6K 1% 1/2W
R26 4.7K
R14 80.6K 1% 1/2W
R16 4.7K
R14B SEL
R24B SEL
C14 1µF 50V
C24 1µF 50V
Q21 2N4401
R57 10K
D52
Q5 2N4403
R75 22K
R73 68K
R72 SEL
R51 3K
R19 SEL
R29 SEL
SL1
T11
T21
C8 .001µF 200V
SL1 600T
Q2 2N4401
C5 .001µF 200V
D53
Q6 2N4401
R18 4.7K 1W
R28 4.7K 1W
CURR. LIMIT P3 5K
CW
R160 3K
R63 360K
R56 2K
D62
R52 2.7K
R53 1.8K
R54 1K 1W
R55 700Ω 3W
R62 62K
C62 2.2µF 100V
D61
T1
20V
D2
D1
R69 510Ω
D63
R64 1M
D3
D4
R68 390Ω
D64
R66 3K
R67 620Ω
C63 22µF 50V
A1 741C
R21 75Ω 10W
C21 22µF 50V
D22
D21
C23 4.7µF, 100V
C22 .47µF 100V
SCR Z1 C106A-41
C25 .1µF 50V
R22 47Ω
TWISTED PAIR
R23 100Ω 1W
R20 10Ω 2W
R60 3K
T2 190060 .01
D43
D41
D44
D42
R41 150Ω
C41 22µF 100V
P1 5K
CW
R44 910Ω
R43 10K 2W
R42 10K 2W
SL1 900T
R45 *
R9
LOAD
OR
NOTES
UNLESS OTHERWISE SPECIFIED;
1. DIODES ARE IN4003.
2. RESISTORS ARE 1/4W CARBON.
3. SL1 – 190116.01
4. T11 – T21 – 161133.00
* 5. SEE CHART ON SHT. 4.

4	3	373194	A

REVISIONS

A 12286 C13, C23 WAS 3.3μF 20% CA5086

PRIMARY FOR 416 OR 480V 50/60 HZ

PRIMARY FOR 120, 277, 380, OR 600V 50/60 HZ

PRIMARY FOR 208 OR 240 50/60HZ ONLY

R1 270Ω 2W
R2 270Ω 2W
R3 SEL
R4 3.9K
R5 1.5K 2W
R6 5K1
R7 22K
R8 20K
R9 100K
R10 10Ω 2W
R11 75Ω 10W
R12 47Ω
R13 100Ω 1W
R44 13K

Z1 1N4737A
Z2 1N4737A
Z3 1N4737A
Z4 1N4737A
Z5 1N4739A

D5
D6
D7
D9
D10
D12
D15

Q1 2N4403

C1 47μF 50V
C2 47μF 50V
C3
C4 .47μF 100V
C11 22μF 50V
C12 .47μF 100V
C13 4.7μF, 100V
C15 .1μF 50V

T1 20V
T1 20V
T11
T21 20VCT

SCR 11 C106A 4:1

TWISTED PAIR
TWISTED PAIR

CT1
F1

STD SUPPRESSO

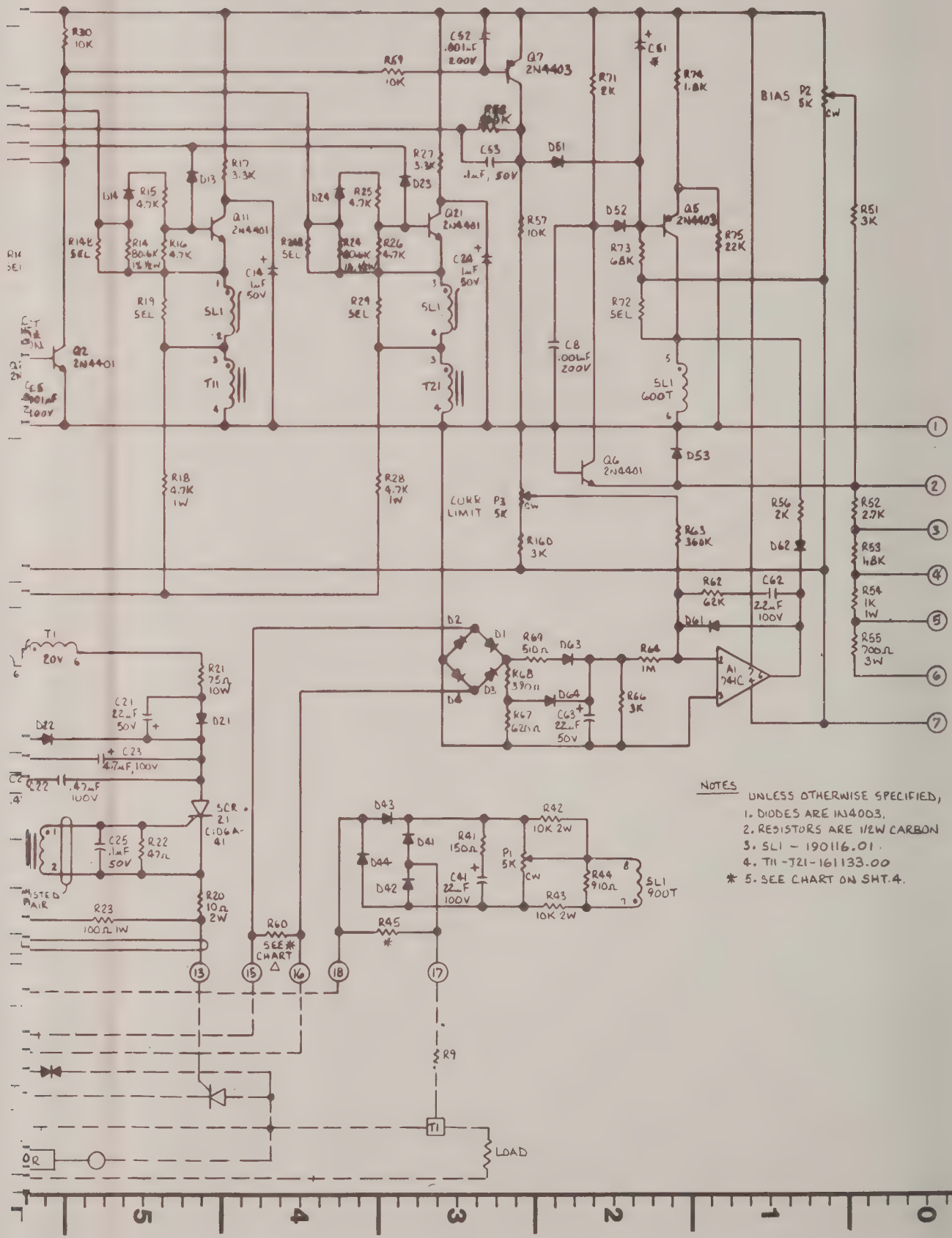
SCALE	—
DATE	9-13-82
DRAWN	RRT
CHECKED	5.A. 11/1/84
WORK ORDER	373194

ROBICON CORP.
PITTSBURGH, PA.

TITLE 1Ø POWER CONTROLLER AC PHASE ANGLE W/C-L, UP TO 100A LOW CURRENT, P/N 464834-XX

DWG. NO. 373194 REVISION A

CONST. CHK. SHT. 4 SHT. NO. 3



NOTES
UNLESS OTHERWISE SPECIFIED,
1. DIODES ARE IN4003.
2. RESISTORS ARE 1/2W CARBON
3. SL1 - 190116.01
4. T11 - T21 - 161133.00
* 5. SEE CHART ON SHT. 4.

PART NUMBER W/O CL	PART NUMBER W CL	AMPS	RAMP	VOLTS	T1	JUMPER TRANSFORMER TERMINALS	C3	C51	R45	USED ON CURRENT LIMIT BOARDS ONLY	
										R60 △	CT △
464833.01	464834.01	10-77	STD	120	161039.00	NO JUMPER	10MF. 25V	22MF. 50V	--	3K. 1/2W	---
↓	.02	100	↓	↓	↓	↓	↓	↓	--	2K. 1W	---
	.03	160-540							--	3K. 1/2W	190060.01
464833.04	.04	10-77		208	161696.01	1-3, 2-4			10K. 2W	3K. 1/2W	---
↓	.05	100		↓	↓	↓			↓	2K. 1W	---
	.06	160-540								3K. 1/2W	190060.01
464833.07	.07	10-77		240	161046.01					3K. 1/2W	---
↓	.08	100		↓	↓					2K. 1W	---
	.09	160-540								3K. 1/2W	190060.01
464833.10	.10	10-77		277	161040.00	NO JUMPER				3K. 1/2W	---
↓	.11	100		↓	↓	↓				2K. 1W	---
	.12	160-540								3K. 1/2W	190060.01
464833.13	.13	10-77		380	161697.01				5K. 3W	3K. 1/2W	---
↓	.14	100		↓	↓				↓	2K. 1W	---
	.15	160-540								3K. 1/2W	190060.01
464833.16	.16	10-77		415	161696.01	2-3				3K. 1/2W	---
↓	.17	100		↓	↓	↓				2K. 1W	---
	.18	160-540								3K. 1/2W	190060.01
464833.19	.19	10-77		480	161046.01					3K. 1/2W	---
↓	.20	100		↓	↓					2K. 1W	---
	.21	160-540								3K. 1/2W	190060.01
464833.22	.22	10-77		600	161698.01	NO JUMPER				3K. 1/2W	---
↓	.23	100		↓	↓	↓				2K. 1W	---
	.24	160-540								3K. 1/2W	190060.01
464833.25	.25	10-77		347	} RESERVED						
↓	.26	100		↓							
	.27	160-540	↓								
464833.31	.31	10-77	LONG	120	161039.00	NO JUMPER	10MF. 25V	100MF. 25V	--	3K. 1/2W	---
↓	.32	100		↓	↓	↓			--	2K. 1W	---
	.33	160-540							--	3K. 1/2W	190060.01
464833.34	.34	10-77		208	161696.01	1-3, 2-4			10K. 2W	3K. 1/2W	---
↓	.35	100		↓	↓	↓			↓	2K. 1W	---
	.36	160-540								3K. 1/2W	190060.01

		.38	100		240	161046.01							2K. 1W		
		.39	160-540										3K. 1/2W	190060.01	
464833.40		.40	10-77		277	161040.00	NO JUMPER						3K. 1/2W	---	
		.41	100										2K. 1W	---	
		.42	160-540										3K. 1/2W	190060.01	
464833.43		.43	10-77		380	161697.01						5K. 3W	3K. 1/2W	---	
		.44	100										2K. 1W	---	
		.45	160-540										3K. 1/2W	190060.01	
464833.46		.46	10-77		415	161696.01	2-3						3K. 1/2W	---	
		.47	100										2K. 1W	---	
		.48	160-540										3K. 1/2W	190060.01	
464833.49		.49	10-77		480	161046.01							3K. 1/2W	---	
		.50	100										2K. 1W	---	
		.51	160-540										3K. 1/2W	190060.01	
464833.52		.52	10-77		600	161698.01	NO JUMPER						3K. 1/2W	---	
		.53	100										2K. 1W	---	
		.54	160-540										3K. 1/2W	190060.01	
464833.55		.55	10-77		347	RESERVED									
		.56	100												
		.57	160-540												
464833.61		.61	10-77	FAST	120	161039.00	NO JUMPER	2.2MF. 50V	3.3MF. 50V				3K. 1/2W	---	
		.62	100										2K. 1W	---	
		.63	160-540										3K. 1/2W	190060.01	
464833.64		.64	10-77		208	161696.01	1-3, 2-4					10K. 2W	3K. 1/2W	---	
		.65	100										2K. 1W	---	
		.66	160-540										3K. 1/2W	190060.01	
464833.67		.67	10-77		240	161046.01							3K. 1/2W	---	
		.68	100										2K. 1W	---	
		.69	160-540										3K. 1/2W	190060.01	
464833.70		.70	10-77		277	161040.00	NO JUMPER						3K. 1/2W	---	
		.71	100										2K. 1W	---	
		.72	160-540										3K. 1/2W	190060.01	
464833.73		.73	10-77		380	161697.01						5K. 3W	3K. 1/2W	---	
		.74	100										2K. 1W	---	
		.75	160-540										3K. 1/2W	190060.01	
464833.76		.76	10-77		415	161696.01	2-3						3K. 1/2W	---	
		.77	100										2K. 1W	---	
		.78	160-540										3K. 1/2W	190060.01	
464833.79		.79	10-77		480	161046.01							3K. 1/2W	---	
		.80	100										2K. 1W	---	
		.81	160-540										3K. 1/2W	190060.01	
464833.82		.82	10-77		600	161698.01	NO JUMPER						3K. 1/2W	---	
		.83	100										2K. 1W	---	
		.84	160-540										3K. 1/2W	190060.01	
464833.85		.85	10-77		347	RESERVED									
		.86	100												
		.87	160-540												

CONT. SHEET --- | SHEET NO. 4 | DRG. NO. 373194 | REV.

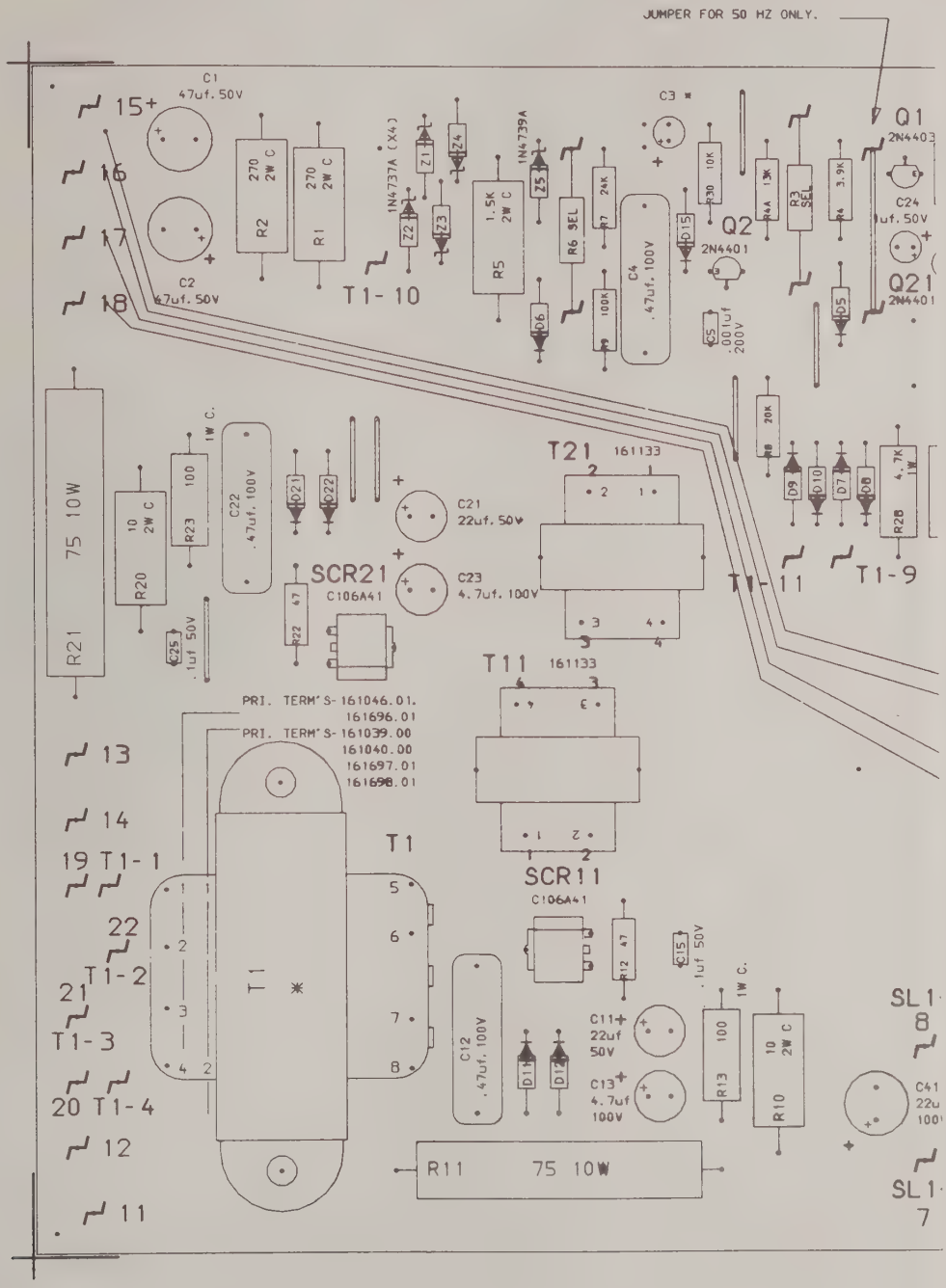
REVISIONS | DFTG. CODE NO.

SCALE NONE
DATE 12-14-83
DRAWN RRT
REVIEW RCB
CHECK SB 1/11/84 SB
APPROVED 1/12/84 RCB

BARBER COLMAN COMPANY
ROBICON CORPORATION
A BARBER-COLMAN COMPANY
CUSTOMER
WORK ORDER STD NO. OF SHEETS

TITLE 1φ POWER CONTROLLER
AC PHASE ANGLE
P/N 464833 & 464834

DRG. NO. 373194 REVISION
CONT. ON SHEET --- SHEET NO. 4

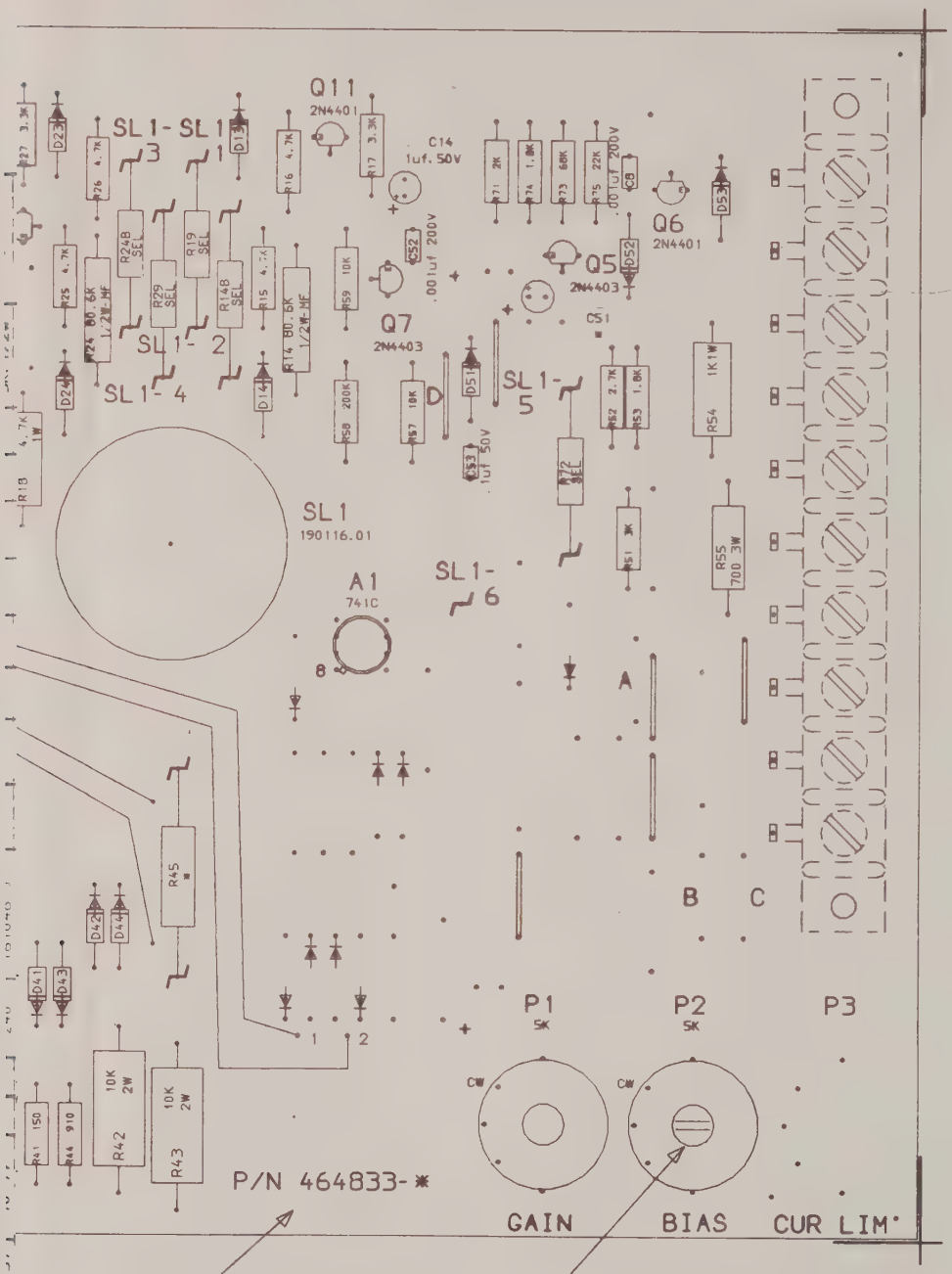


NOTES: UNLESS OTHERWISE SPECIFIED:

1. RESISTORS ARE 1/2W. CARBON.
2. DIODES ARE 1N4003.
3. BEFORE TEST - SOLDER ONE END OF R45.
   LEAVE ONE END DISCONNECTED.
   AFTER TEST - SOLDER OTHER END OF R45.
   JUMPER TERMINAL 18 TO 20.

REVISIONS		
B	C13 AND C23 WERE 3.3uf	RRTS/7/84

CODE NO. 1228G



4. * SEE CHART ON DWG. 373194 SHT.4.
5. ADD JUMPER D WHEN R80 IS USED.

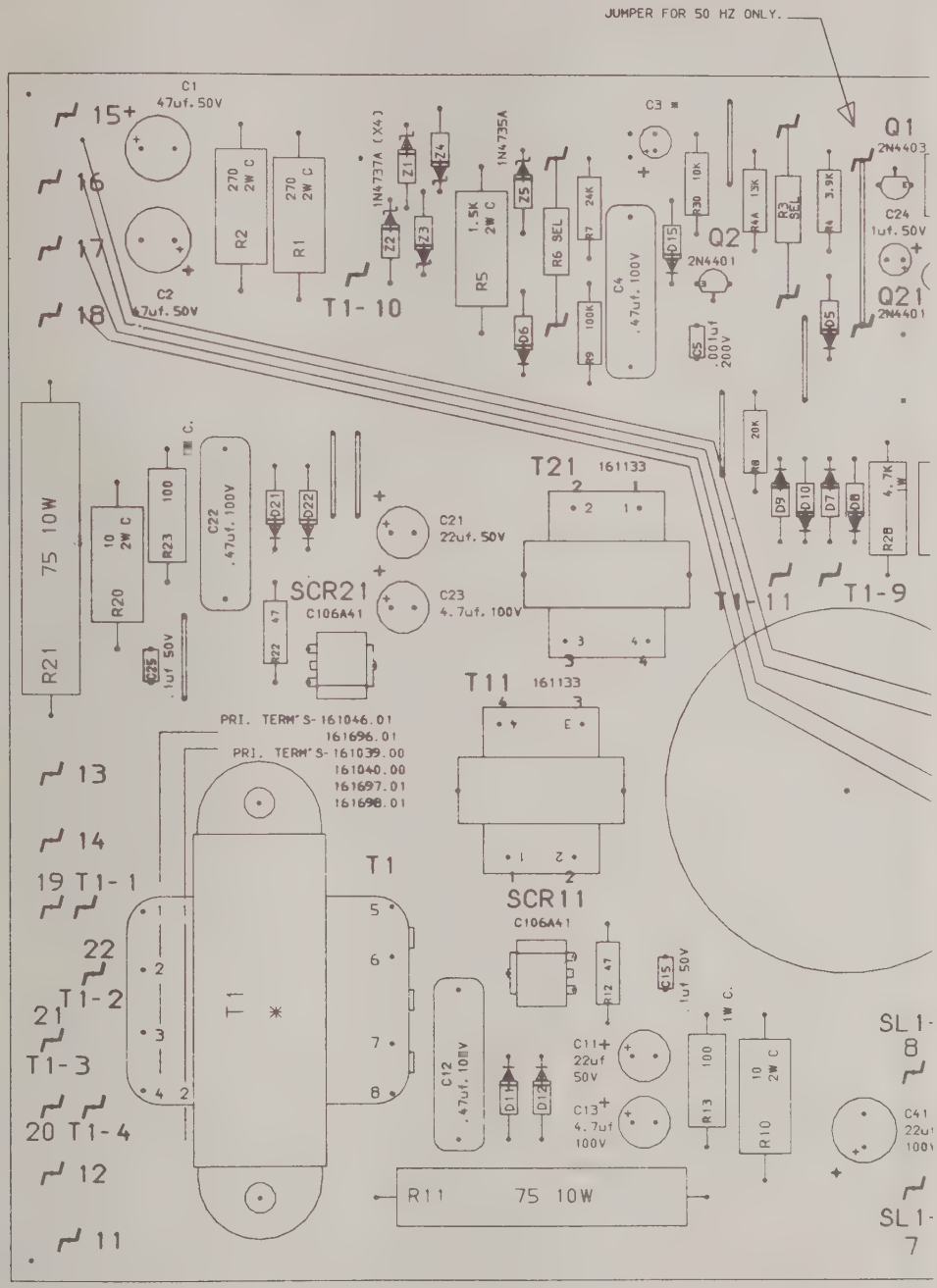
SCALE	2" = 1"
DATE	11-8-83
DRAWN	RRT
REVIEW	SB
CHECK	SB
APPROVE	RCB

COLMAN
ROBICON CORPORATION
A BARBER-COLMAN COMPANY
CUSTOMER
WORK ORDER --- NO. OF SHEETS

TITLE ASSEMBLY
1 PHASE PWR. CONT.
W/O C.L.

DWG. NO. 464833 REVISION B
CONT. ON SHEET - - - SHEET NO. 1

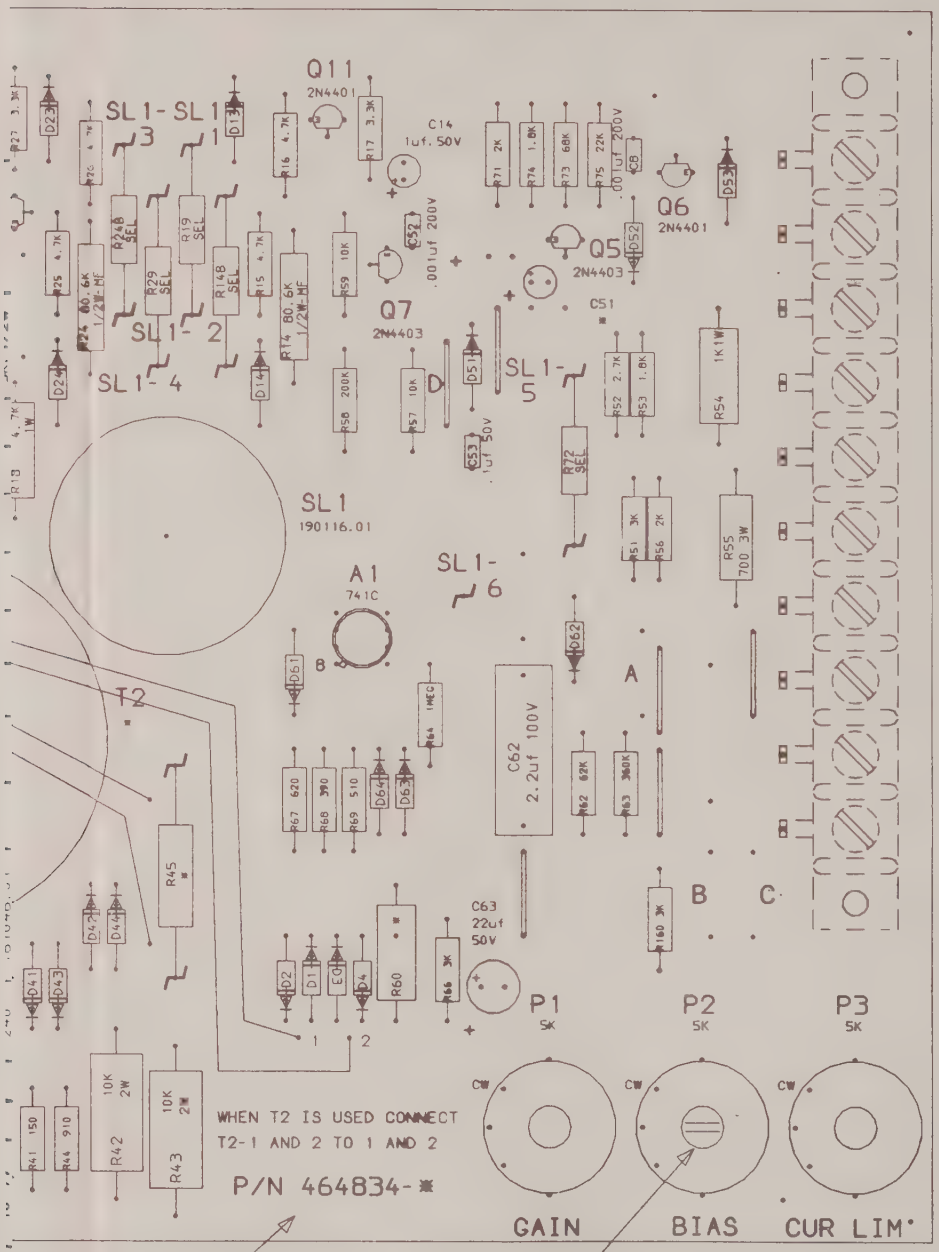
WHEN T2 IS USED CONNECT
T2-3 TO 15 AND T2-4 TO 16



NOTES: UNLESS OTHERWISE SPECIFIED:

1. RESISTORS ARE 1/2W. CARBON.
2. DIODES ARE 1N4003.
3. BEFORE TEST - SOLDER ONE END OF R45.
   LEAVE ONE END DISCONNECTED.
   AFTER TEST - SOLDER OTHER END OF R45.
   JUMPER TERMINAL 18 TO 20.

REVISIONS		DATE:	CODE NO. 1228G
B	C13 AND C23 WERE 3.3uf RATES/8/84		



4. *- SEE CHART ON DWG. 373194 SHT.4.
5. ADD JUMPER D WHEN R80 IS USED.

SCALE	2" - 1"	ROBICON CORPORATION	TITLE: ASSEMBLY 1 PHASE PWR. CON W/ C.L.
DATE	11-8-83		DWG. NO. 464834
DRAWN	RRT		
REVIEW	SB		
CHECK	SB	CUSTOMER -	CONT. ON SHEET - - -
APPROVE	RCB	WORK ORDER - - - NO. OF SHEETS -	SHEET NO.

NOTES:

1. THE SERIES 440 SINGLE PHASE SCR/PLASTIC PAK POWER CONTROLLERS PROVIDE SOLID STATE PHASE ANGLE CONTROL OF AC POWER. THE SCR'S/PLASTIC PAK'S SERVE AS SOLID STATE SWITCHES WHICH, WHEN CLOSED, APPLY LINE VOLTAGE TO THE LOAD. IN PHASE ANGLE CONTROL, EACH SCR/PLASTIC PAK IS TURNED ON FOR A CONTROLLED PORTION OF A HALF CYCLE OF THE LINE VOLTAGE. THE EFFECTIVE VOLTAGE (HENCE, POWER) IS DETERMINED BY THE PORTION OF THE LINE VOLTAGE DELIVERED. THE LOAD VOLTAGE CAN THEN BE VARIED BY SELECTING THE FIRING TIME OF EACH SCR/PLASTIC PAK.

   THESE UNITS MAY BE OPERATED INTO RESISTIVE OR INDUCTIVE LOADS DRIVEN EITHER DIRECTLY OR THROUGH AN INTERPOSING TRANSFORMER OR VARIABLE AUTOTRANSFORMER.

   SPECIAL PRECAUTIONS ARE NECESSARY TO LIMIT PEAK INRUSH CURRENTS WHEN THESE UNITS ARE DRIVING CAPACITIVE OR TUNGSTEN LAMP LOADS. AN EXAMPLE OF THE FORMER TYPE OF LOAD IS A RECTIFIER BRIDGE WITH LARGE AMOUNTS OF FILTERING. UNITS HAVING A .03 OR .04 AS THE PART NUMBER SUFFIX HAVE A 4 SECOND RAMP BUILT IN TO LIMIT THE RATE OF RISE OF THE OUTPUT VOLTAGE TO PREVENT FIRING INTO A COLD LOAD. THESE UNITS ARE INTENDED FOR OPERATION INTO HIGH INRUSH LOADS.

2. POWER CONNECTIONS:

   CHECK INFORMATION IN TABLE I, SH.2 FOR VOLTAGE AND CURRENT RATINGS AND TERMINAL LUG INFORMATION.

   CONNECT ONE SIDE OF THE LOAD TO T1. CONNECT ONE SIDE OF THE LINE TO L1. CONNECT THE OTHER SIDE OF THE LINE TO THE REMAINING SIDE OF THE LOAD AND RUN A SEPARATE LEAD FROM THIS JUNCTION TO SCREW TERMINAL L2. THIS IS FOR CONTROL PURPOSES ONLY. MAKE SURE ALL CONNECTIONS ARE TIGHT. ALL UNITS ARE RATED FOR NOMINAL VALUE OF LINE ±10%, 50/60 Hz. STANDARD RATINGS ARE 120V,208V,240V,277V,380V,415V,480V & 600V. UNITS SHUT DOWN AUTOMATICALLY IF LINE VOLTAGE DROPS BELOW 70% OF NOMINAL VALUE. NORMAL OPERATION WILL RETURN WITH RECOVERY OF LINE VOLTAGE.

   RMS LOAD VOLTAGE IS CONTROLLABLE FROM ZERO TO 96% OF LINE VOLTAGE. LINEARITY IS ±2% OF FULL OUTPUT VOLTAGE FROM 5% TO 96% OF THE INPUT VOLTAGE.

   REFER TO THE NAMEPLATE FOR CURRENT RATING. RMS LOAD CURRENT RATING IS FOR CONTINUOUS OPERATION IN FREE AIR AT AMBIENT TEMPERATURES OF 50°C (122°F) OR LESS. THE LOAD RESISTANCE SHOULD BE SUCH THAT UNDER CONDITIONS OF MAXIMUM LINE VOLTAGE THE NAMEPLATE CURRENT RATING IS NOT EXCEEDED. TYPICAL MOMENTARY OVERLOAD CAPABILITY IS 300% OF RMS NAMEPLATE RATING FOR 10 CYCLES.

3. CONTROL INPUT CONNECTIONS:

COMMAND INPUT CONNECTIONS
(DC MILLIAMPERE CONTROL)

INPUT CONTROL CURRENT (mA F.S.)	INPUT TERMINAL RESISTANCE (OHMS)	CONNECT TO TERMINALS (TERM. #1 POS.)	JUMPER TERMINALS	MAX. ALLOWABLE CURRENT (mA)
5	2K	1 & 4	2 & 3	20
5	3K	1 & 3	- - -	12
7	4K	1 & 5	3 & 4	12
12	1.5K	1 & 3	5 & 1	24
20	0.8K	1 & 4	3 & 4 5 & 1	40
20	1.2K	1 & 4	6 & 1	40
50	600	1 & 5	6 & 1	70
20	500	1 & 5	4 & 5 2 & 3 6 & 1	40

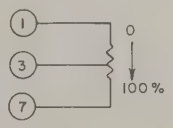
TYPICAL INPUT CONNECTIONS

OTHER INPUT RANGES AND INPUT RESISTANCE VALUES OBTAINABLE WITH COMBINATIONS OF INTERNAL AND/OR EXTERNAL RESISTORS. CONTROL MAY BE APPLIED OF OPPOSITE POLARITY AS SHOWN. IN ANY CASE, CURRENT THROUGH CONTROL TRANSISTOR MUST NOT EXCEED 8 mA.

TERMINALS - 6-32 SCREW CONNECTION.

MANUAL CONTROL:

CONNECT 3000 OHM. 1/2W POTENTIOMETER AS FOLLOWS:

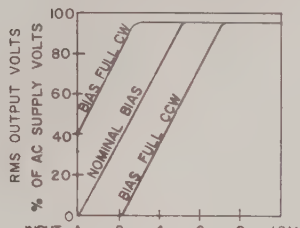


4. DIELECTRIC TEST VOLTAGES:

	INPUT VOLTAGE RATING					
	120	208	240	277	480	VAC NOM
CONTROL CIRCUIT TO GROUND	1000	1000	1000	1000	1000	VAC MIN
POWER CIRCUIT TO CONTROL CIRCUIT	1500	1500	1500	1600	2000	VAC MIN.
POWER CIRCUIT TO GROUND	1500	1500	1500	1600	2000	VAC MIN.

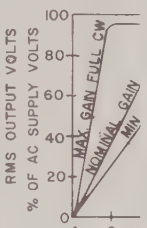
5. GAIN AND BIAS CONTROLS: GAIN AND BIAS ARE FACTORY S SETTINGS AS INDICATED BELOW (0-5 mA NOMINAL RANGE).

TYPICAL BIAS CHARACTERISTICS WITH NOMINAL GAIN SETTING



INPUT A	2	4	6	8	10MA	
INPUT B	8	16	24	32	40MA	
INPUT C	20	40	60	MAX	MA	
MANUAL	33%	67%	100%			

TYPICAL GAIN WITH NOMINA



A	2	
B	8	
C	20	
MANUAL	33%	

6. CURRENT LIMIT OPTION:

   THE CURRENT LIMIT ADJUST POTENTIOMETER WILL BE FACTOR THE CURRENT TO RATED VALUE. THE CURRENT LIMIT SET PO FROM ZERO TO APPROXIMATELY 140% OF RATED CURRENT. IF SET POINT IS TO BE DECREASED, TURN THE CURRENT LIMIT METER COUNTERCLOCKWISE. CONVERSELY, IF IT IS DESIRED THE CURRENT LIMIT SET POINT, TURN THE CURRENT LIMIT A METER CLOCKWISE.

7 SEE INSTRUCTION MANUAL 900 919 FOR ADDITIONAL DETAILS GAIN, TROUBLE SHOOTING AIDS, SCHEMATICS AND PART LAYO

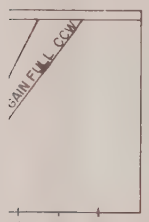
CONT SHEET 2
SHEET NO 1
DWG NO 440 100
REV

MASTER
DRTO CODE NO 1234V

REVISIONS
A SUP 4 BRACKET PART NO 67 WAS PART NO 68 PER ECO 1255

ET AT NOMINAL

CHARACTERISTICS
L BIAS SETTING

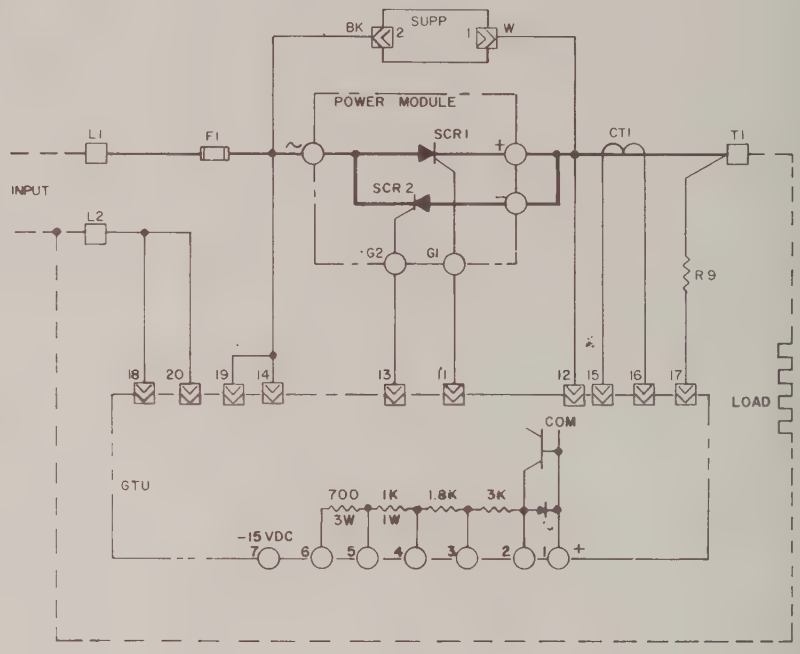


4 6 8 10MA
16 24 32 40MA
40 60 MAX MA
67% 100%

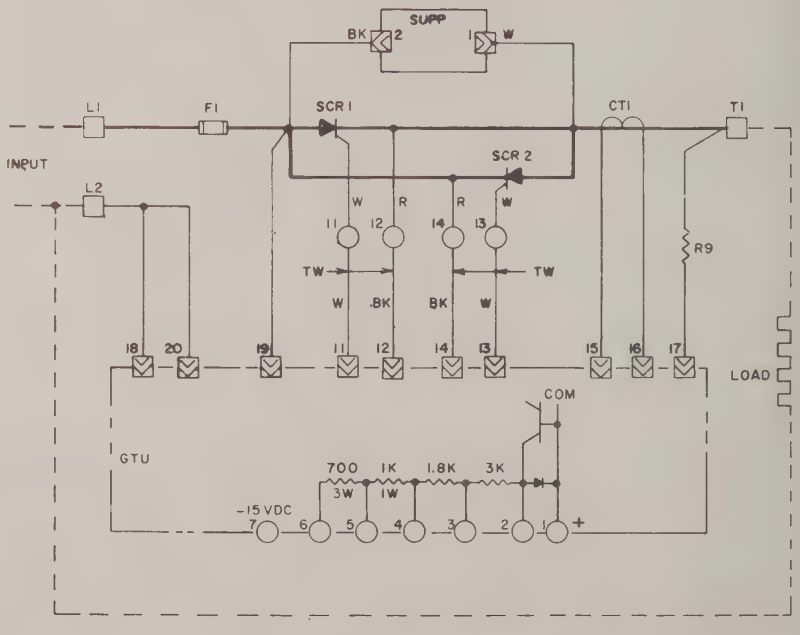
F SET TO LIMIT
INT IS ADJUSTABLE
THE CURRENT LIMIT
ADJUST POTENTIO-
TO INCREASE
DJUST POTENTIO-

IN SETTING BIAS/
JTS

SCHEMATIC A



SCHEMATIC B



SCALE NTS	COLMAN	TITLE 1Ø PHASE ANGLE CONTROLLER	
DATE 3-1-84	Robicon Corporation	NOTES, SCHEMATICS	
DRAWN KJB	A BARBER COLMAN COMPANY	DWG NO 440100	REVISION A
REVIEW	CUSTOMER	CONT ON SHEET 2	SHEET NO. 1
CHECK	WORK ORDER	NO OF SHEETS	
APPROVE			

TABLE 1

REPLACE

ROBICON P/N	VOLTS	AMPS	OUT. FIG.	SCHEMATIC FIG.	PRESSURE LUG L1. T1 POWER	PRESSURE LUG L2. CONTROL	ROBICON SCR1-2	F1	FUSE MFG.	ROBICC SUPP
440102	120	25	1	A	12-14	12-14	261029.28	KAC30	BUSS	168100
440103		50	2		4-18		261029.16	A25X50-4	GOULD-SH	
440104		75	3				261029.22	A25X80-4		
440105		100	3		1/0-12			A25X150-4		
440107		160	4	B	250MCM-6		261056.03	A25X200-4		
440108		220	4				261056.21	A25X250-4		
440110		310	5		350MCM-6			A25X350-4		
440111		400	5		600MCM-4/0		261057.29	A25X500-4		
440112		550	5		1000-500MCM		261058.31	A25X600-4		
440602	208	25	1	A	12-14	12-14	261029.28	KAC30	BUSS	168100.
440603		50	2		4-18		261029.16	A25X50-4	GOULD-SH	
440604		75	3				261029.22	A25X80-4		
440605		100	3		1/0-12			A25X150-4		
440607		160	4	B	250MCM-6		261056.03	A25X200-4		
440608		220	4				261056.21	A25X250-4		
440610		310	5		350MCM-6			A25X350-4		
440611		400	5		600MCM-4/0		261057.29	A25X500-4		
440612		550	5		1000-500MCM		261058.31	A25X600-4		
440202	240	25	1	A	12-14	12-14	261029.28	KAC30	BUSS	168100.
440203		50	2		4-18		261029.16	A25X50-4	GOULD-SH	
440204		75	3				261029.22	A25X80-4		
440205		100	3		1/0-12			A25X150-4		
440207		160	4	B	250MCM-6		261056.03	A25X200-4		
440208		220	4				261056.21	A25X250-4		
440210		310	5		350MCM-6			A25X350-4		
440211		400	5		600MCM-4/0		261057.29	A25X500-4		
440212		550	5		1000-500MCM		261058.31	A25X600-4		
440402	277	25	1	A	12-14	12-14	261029.29	KAC30	BUSS	168100.
440403		50	2		4-18		261029.17	A50P50-4	GOULD-SH	
440404		75	3				261029.23	A50P80-4		
440405		100	3		1/0 12			A50P125-4		
440407		160	4	B	250MCM-6		261056.06	A50P200-4		
440408		220	4				261056.24	A50P250-4		
440410		310	5		350MCM-6			A50P350-4		
440411		400	5		600MCM-4/0		261057.32	A50P500-4		
440412		550	5		1000-500MCM		261058.25	A50P600-4		
440702	380	25	1	A	12-14	12-14	261029.29	KAC30	BUSS	168100.
440703		50	2		4-18		261029.17	A50P50-4	GOULD-SH	
440704		75	3				261029.23	A50P80-4		
440705		100	3		1/0-12			A50P125-4		
440707		160	4	B	250MCM-6		261056.06	A50P200-4		
440708		220	4				261056.24	A50P250-4		
440710		310	5		350MCM-6			A50P350-4		
440711		400	5		600MCM-4/0		261057.32	A50P500-4		
440712		550	5		1000-500MCM		261058.25	A50P600-4		
440802	415	25	1	A	12-14	12-14	261029.29	KAC30	BUSS	168100.
440803		50	2		4-18		261029.17	A50P50-4	GOULD SH	
440804		75	3				261029.23	A50P80 4		
440805		100	3		1/0-12			A50P125-4		
440807		160	4	B	250MCM-6		261056.06	A50P200-4		
440808		220	4				261056.24	A50P250 4		
440810		310	5		350MCM-6			A50P350 4		
440811		400	5		600MCM-4/0		261057.32	A50P500-4		
440812		550	5		1000-500MCM		261058.25	A50P600-4		
440302	480	25	1	A	12-14	12-14	261029.29	KAC30	BUSS	168100.
440303		50	2		4-18		261029.17	A50P50-4	GOULD-SH	
440304		75	3				261029.23	A50P80-4		
440305		100	3		1/0-12			A50P125-4		
440307		160	4	B	250MCM-6		261056.06	A50P200-4		
440308		220	4				261056.24	A50P250 4		
440310		310	5		350MCM-6			A50P350-4		
440311		400	5		600MCM-4/0		261057.32	A50P500-4		
440312		550	5		1000-500MCM		261058.25	A50P600-4		
440502	600	25	1	A	12-14	12-14	261029.30	KAC30	BUSS	168100.
440503		50	2		4-18		261029.18	A70P50-4	GOULD-SH	
440504		75	3				261029.24	A70P80-4		
440505		100	3		1/0 12			A70P125-4		
440507		160	4	B	250MCM-6		261056.07	A70P200 4		
440508		220	4				261056.25	A70P250-4		
440510		310	5		350MCM-6			A70P350-4		
440511		400	5		600MCM-4/0		261057.33	A70P500-4		
440512		550	5		1000-500MCM		261058.26	A70P600-4		

CONT. SHEET 3
SHEET NO. 2
DRWG. NO. 440100
REV -

REVISIONS

MENT PARTS

	*ROBICON USED W/C-L ONLY CT1	RESISTOR R9		GTU-GATE TRIGGER UNIT					
		ROBICON	RATING	.01 STD RAMP W/O C-L	.02 STD RAMP W/C-L	.03 LG. RAMP W/O C-L	.04 LG. RAMP W/C-L	.05 FT. RAMP W/O C-L	.06 FT. RAMP W/C-L
.01	*190171.10	261082.00	1.5K. 12W	464833.01	464834.01	464833.31	464834.31	464833.61	464834.61
					464834.02		464834.32		464834.62
	64-201 (EI)				464834.03		464834.33		464834.63
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
02	*190171.10	261082.01	5K. 12W	464833.04	464834.04	464833.34	464834.34	464833.64	464834.64
					464834.05		464834.35		464834.65
	64-201 (EI)				464834.06		464834.36		464834.66
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
02	*190171.10	261082.01	5K. 12W	464833.07	464834.07	464833.37	464834.37	464833.67	464834.67
					464834.08		464834.38		464834.68
	64-201 (EI)				464834.09		464834.39		464834.69
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
03	*190171.10	261082.01	5K. 12W	464833.10	464834.10	464833.40	464834.40	464833.70	464834.70
					464834.11		464834.41		464834.71
	64-201 (EI)				464834.12		464834.42		464834.72
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
04	*190171.10	261082.02	10K. 50W	464833.13	464834.13	464833.43	464834.43	464833.73	464834.73
					464834.14		464834.44		464834.74
	64-201 (EI)				464834.15		464834.45		464834.75
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
04	*190171.10	261082.02	10K. 50W	464833.16	464834.16	464833.46	464834.46	464833.76	464834.76
					464834.17		464834.47		464834.77
	64-201 (EI)				464834.18		464834.48		464834.78
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
04	*190171.10	261082.02	10K. 50W	464833.19	464834.19	464833.49	464834.49	464833.79	464834.79
					464834.20		464834.50		464834.80
	64-201 (EI)				464834.21		464834.51		464834.81
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								
05	*190171.10	261082.03	12K. 50W	464833.22	464834.22	464833.52	464834.52	464833.82	464834.82
					464834.23		464834.53		464834.83
	64-201 (EI)				464834.24		464834.54		464834.84
	64-201 (EI)								
	64-401 (EI)								
	64-401 (EI)								
	74-601 (EI)								

SCALE	NONE	BARBER COLMAN	TITLE 1φ PHASE ANGLE CONTROLLER REPLACEMENT PARTS
DATE	03-01-84	ROBICON CORPORATION	DWG. NO. 440100 REVISION A
DRAWN	KJB	A BARBER-COLMAN COMPANY	CONT. ON SHEET 3 SHEET NO. 2
REVIEW			
CHECK		CUSTOMER	
APPROVE	RCB	WORK ORDER NO. OF SHEETS 4	

FIG. 1
25A

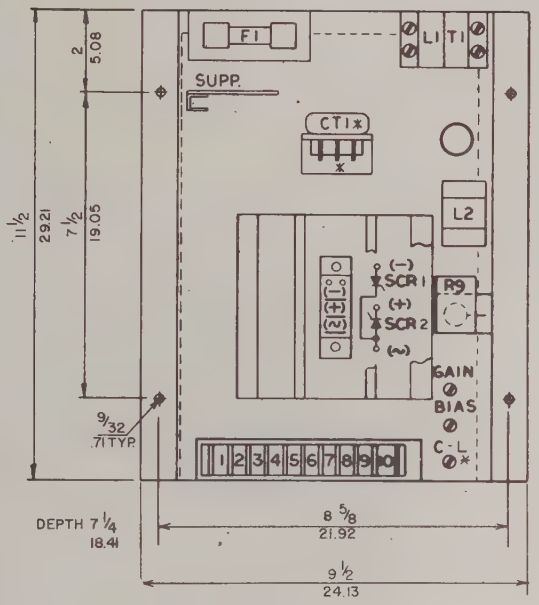
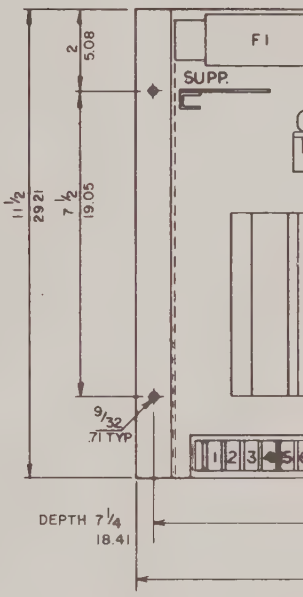


FIG. 2
50A



NOTES
A TOP DIMENSION IS INCHES
B BOTTOM DIMENSION IS CENTIMETERS
C ALL FIG. ARE FRONT VIEW UNLESS OTHERWISE NO
D ALL GTU CUSTOMER CONTROL CONNECTIONS ARE 16-14 AWG 20A 300V, 6-32 WIRE CLAMP, UL
E * USED WITH CURRENT LIMIT UNITS ONLY.

CONT SHEET 4
SHEET NO 3
DWG NO 440 100
REV
REVISIONS

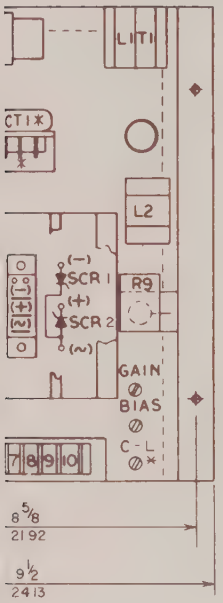
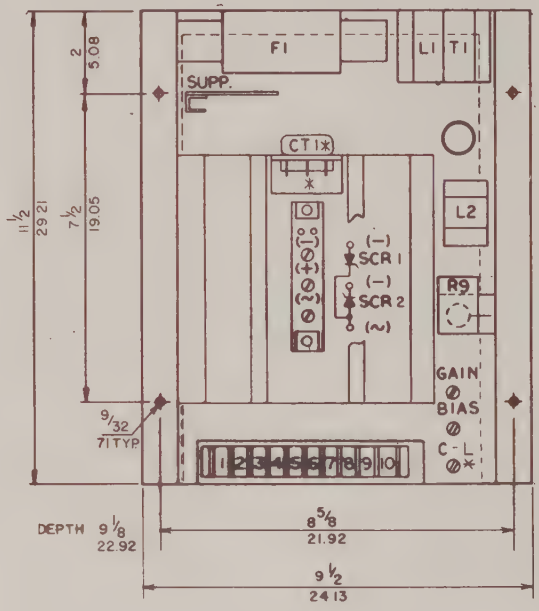


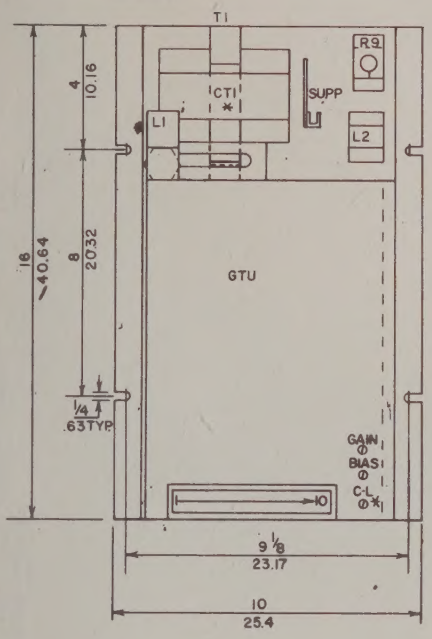
FIG. 3
75/100A

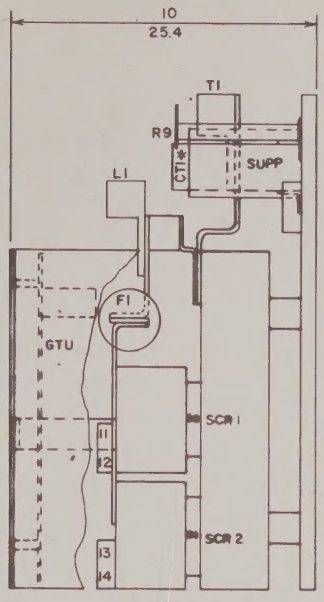


ED

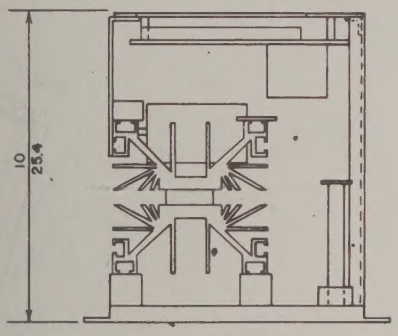
SCALE 1/2 = 1	COLMAN	TITLE 1Ø PHASE ANGLE CONTROLLER	
DATE 3-1-84	Robicon Corporation	OUTLINE FIG. 1,2,3	
DRAWN KJB	A BARBER-COLMAN COMPANY	DWG NO 440 100	REVISION A
REVIEW [illegible]	CUSTOMER	CONT ON SHEET 4	SHEET NO 3
CHECK	WORK ORDER	NO OF SHEETS	
APPROVE [illegible] 3/26/84			

FIG. 4
160/220A





SIDE VIEW

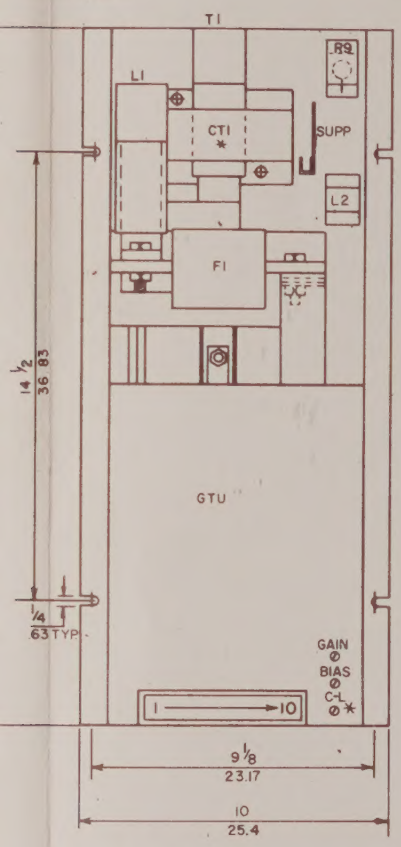


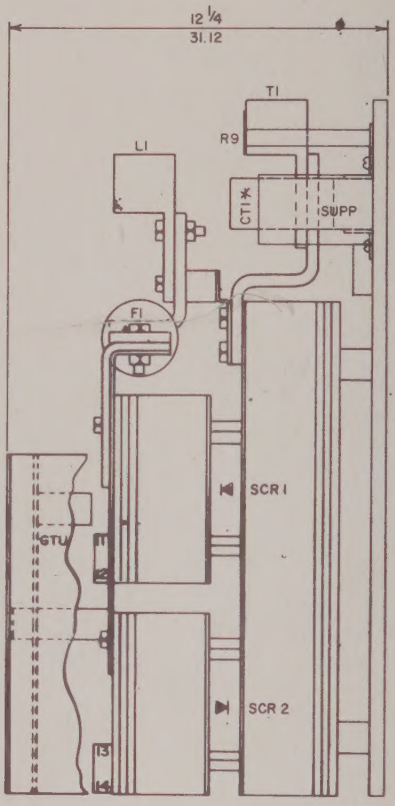
END VIEW

NOTES:
A TOP DIMENSION IS INCHES.
B BOTTOM DIMENSION IS CENTIMETERS.
C ALL FIG. ARE FRONT VIEW UNLESS OTHERWISE NOTED.
D ALL GTU CUSTOMER CONTROL CONNECTIONS ARE 16-14 AWG 20A 300V, 6-32 WIRE CLAMP, UL
E SEE RIGHT SIDE VIEW FOR SCR ORIENTATION (TYPICAL FOR FIG 4 AND 5).
F *USED WITH CURRENT LIMIT UNITS ONLY.

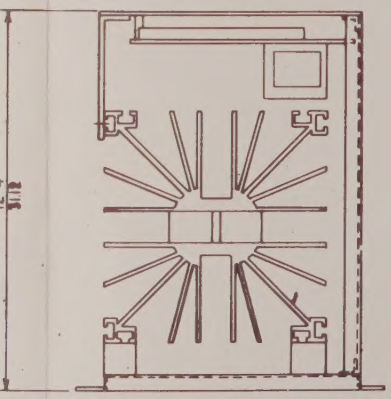
CONT SHEET ~
SHEET NO 4
DWG NO 440100
REV
REVISIONS
SIZE CODE NO 83

FIG. 5
310/400/550A





SIDE VIEW



END VIEW

SCALE 3/8 = 1	COLMAN Robicon Corporation A BARBER-COLMAN COMPANY	TITLE 1Ø PHASE ANGLE CONTROLLER	
DATE 3-1-84		OUTLINE FIG. 4,5	
DRAWN KJB		DWG NO 440 100	REVISION
REVIEW	CUSTOMER	CONT ON SHEET ~	SHEET NO. 4
CHECK	WORK ORDER / NO OF SHEETS		
APPROVED 3/26/84			

MP MASTER
MA32118